

# Cardiac Sciences

## Objectives:

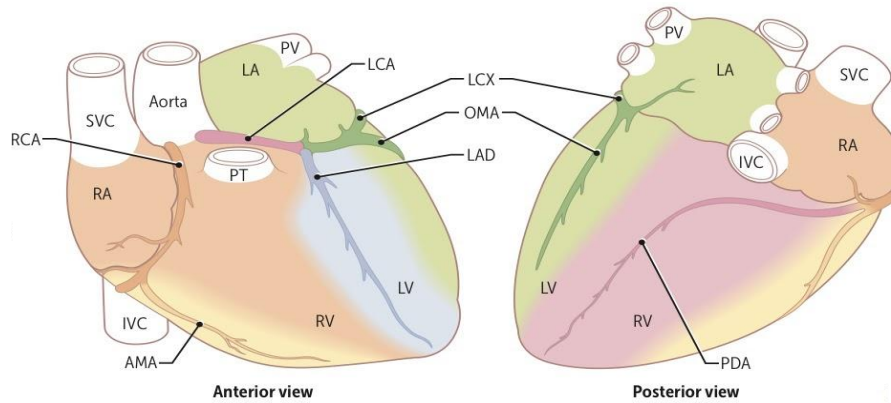
- To identify the indications for surgical intervention in coronary artery disease.
- To identify the indications for surgical intervention in valvular heart disease.
- To identify the indications for surgical intervention in end stage heart failure patients.
- To explain the main objectives of coronary bypass surgery.
- To compare different prostheses used in surgical valve replacement.
- To explain differences in different surgical therapies for end stage heart failure patients

### Color index:

Main Text	Textbook
Males slides	Important
Females slides	Golden notes
Past notes	Extra
442 notes	

# Overview

## Anatomy of the heart



- Mitral valve has **2 leaflets** and it is **attached to the left ventricle** via chordae tendineae
- Tricuspid valve has **3 leaflets** and it is **attached to the right ventricle** via chordae tendineae
- We have two main coronary arteries:
  - Left coronary artery (LCA) supplies **75% of the heart**
  - Right coronary artery (RCA) supplies **25% of the heart**
- LCA gives:
  - **Left anterior descending artery (LAD)** supplies **75%** (supplies 50% of the whole heart so it is the most important artery) (**most commonly involved in IHD**)
  - **Left circumflex artery (LCX)** supplies 25%
- That's why we **do surgery when LCA stenosed or its equivalent (proximal LAD or LCX)**, we can't save 75% of the heart by PCI

## Common cardiac operations



**Coronary artery bypass grafting (CABG) – most common**



Valve replacement/repair



Repair of congenital defects: VSD or ASD

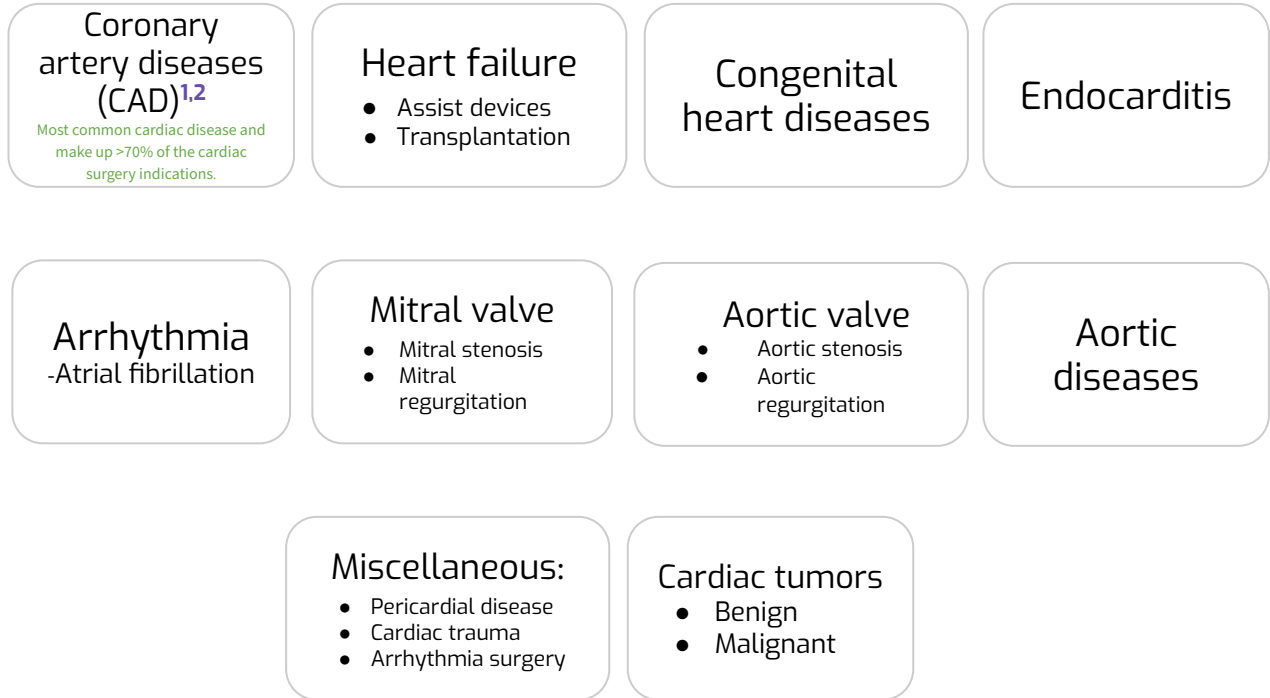


Heart transplantation

# Cardiac disease



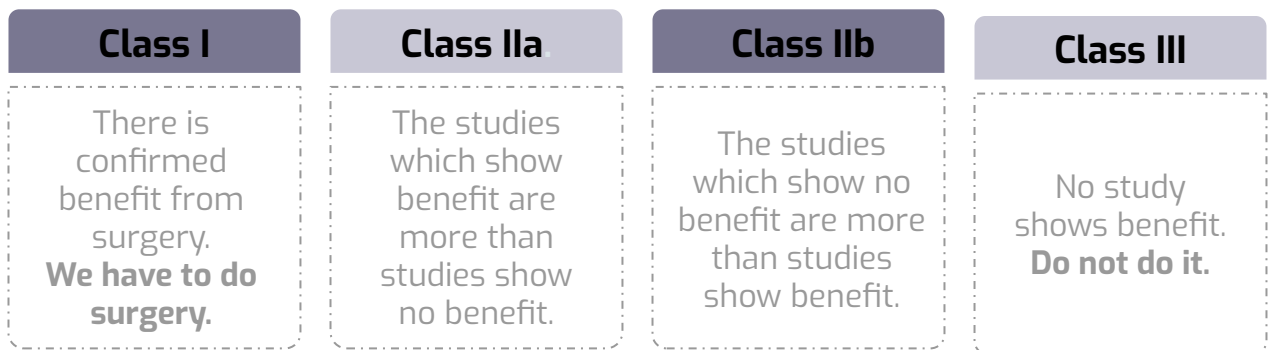
## Type of cardiac disease



## How Do We Approach a Cardiac Patient?



## Classes of surgical indications



- 1- A lot of patients with coronary heart disease or valvular cardiomyopathy and idiopathic cardiomyopathy will have heart failure and eventually they will need either to have surgery for heart failure, assisted devices with mechanical heart or ultimately heart transplant
- 2- there is huge spectrum of pathogens that can affect the human heart mainly we deal with CAD
- 3- Sometimes patients with CAD (stable angina) they have normal physical findings you only discover them through investigations, stress test, coronary angiography



# Presentation of cardiac disease



## Presentation of cardiac disease

### 1-Chest Pain

Most common presentation to the ER

### 2-Lung Congestion

Blood will accumulate in the lung

### 3-Systemic Venous Congestion

Symptom related to the right side of the heart

### 4-Palpitations

### 5-Symptoms due to low cardiac output

### Other modes of presentation



## 1- chest pain

**What important from the table dr said :** I don't expect you at your level right now to know all of these in fine details but You have to understand when somebody come with chest pain you have to think number 1 cardiac causes especially IHD but also when you take the history you have to ask for other symptoms that can show you that the lungs ,GI ,chest wall are not involved

<b>Life-threatening causes</b>	<ul style="list-style-type: none"> <li>• Myocardial infarction</li> <li>• Aortic dissection</li> <li>• Pulmonary embolism</li> <li>• Esophageal rupture</li> <li>• Tension pneumothorax</li> </ul>
<b>Differential Diagnoses of Chest Pain</b>	
<b>Cardiac causes</b>	<ol style="list-style-type: none"> <li>1. Ischemic heart disease "most common"</li> <li>2. Pericarditis.</li> <li>3. Aortic aneurysm</li> <li>4. Aortic dissection.</li> <li>5. Pulmonary embolism</li> <li>6. Mitral valve prolapse</li> <li>7. L.V.O.T(left ventricle outflow tract )obstruction:             <ol style="list-style-type: none"> <li>a. Aortic stenosis</li> <li>B. Hypertrophic obstructive cardiomyopathy</li> </ol> </li> </ol>
<b>Non-cardiac causes</b>	<ul style="list-style-type: none"> <li>• <b>In the chest wall &amp; vertebrae:</b> <ul style="list-style-type: none"> <li>○ Diseases of the breast, myositis, rib fractures</li> <li>○ Diseases of the shoulder joint &amp; costochondritis (inflammation of the ribs)</li> <li>○ Cervical spondylosis &amp; prolapsed cervical disc</li> <li>○ Thoracic outlet syndrome e.g. cervical rib</li> <li>○ Diseases of the spinal cord / nerve roots e.g. radiculitis, tabes dorsalis</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>• <b>In the lungs, pleura, &amp; mediastinum:</b> <ul style="list-style-type: none"> <li>○ Pleural causes: pleurisy, acute pneumothorax</li> <li>○ Lung disease: e.g: bronchitis, pulmonary infarction, pneumonia</li> <li>○ Mediastinitis &amp; mediastinal emphysema &amp; tumor</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>• <b>Abdominal:</b> <ul style="list-style-type: none"> <li>○ Stomach: hiatus hernia, peptic ulcer</li> <li>○ Esophagus: reflux esophagitis, spasm</li> <li>○ Gallbladder: cholecystitis, pancreatitis</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>• <b>Anxiety &amp; cardiac neurosis:</b>              You need to exclude all the organic causes first to diagnose the patient with anxiety             <ul style="list-style-type: none"> <li>○ Stabbing or stitching in nature occurs after exercise, associated coughing, palpitation, sense of suffocation, precordial tenderness &amp; emotional upset</li> </ul> </li> </ul>

# Presentation of cardiac disease



## 2- lung congestion **Dr said: you don't need to know all of these in details**

	<ul style="list-style-type: none"> <li>• Related to the left side of the heart at the level of aortic and mitral valves</li> <li>• In case of aortic stenosis/regurgitation, hypertension, mitral stenosis/regurgitation or VSD</li> <li>• Congestive lung symptoms in cardiac patients occur as a result of:             <ul style="list-style-type: none"> <li>◦ Stagnation of blood behind a failing left atrium or left ventricle (left-sided heart failure)</li> <li>◦ Left-to-right shunts</li> </ul> </li> </ul>
<p><b>Clinically</b> You have to know the symptoms and signs</p>	<p><b>Symptoms:</b> dyspnea, orthopnea, PND, pulmonary edema, cough with expectoration of mucoid sputum "the nature of sputum", easy fatigue &amp; hemoptysis.</p> <p><b>Signs:</b> rapid small pulse volume, pale, cold extremities, crepitations, gallop rhythm, pulsus alternans, functional mitral regurgitation."start by examining the vital signs and start with pulse (rate,character,rhythm) all of these can give you important information about your patient"</p>
<p><b>LV failure</b></p>	<p>When the LV fails → unable to pump all the blood to the circulation</p> <ol style="list-style-type: none"> <li>↓ Cardiac output:             <ul style="list-style-type: none"> <li>• Fatigue</li> <li>• ↓ Blood supply to kidneys → salt &amp; water retention → ↑ blood volume → LL edema</li> <li>• ↓ Blood → skin → pallor &amp; peripheral cyanosis</li> <li>• Cold extremities</li> </ul> </li> <li>↑ Sympathetic activity → tachycardia</li> <li>Blood accumulates in the lungs → pulmonary congestion:             <ul style="list-style-type: none"> <li>◦ Dyspnea on effort</li> <li>◦ Orthopnea</li> <li>◦ PND</li> <li>◦ Acute pulmonary edema</li> <li>◦ Cough</li> <li>◦ Hemoptysis</li> <li>◦ Crepitations</li> <li>◦ Pleural effusion</li> </ul> </li> </ol>
<p><b>Causes of LV failure</b></p>	<ol style="list-style-type: none"> <li><b>Excessive pressure</b> <ul style="list-style-type: none"> <li>◦ Aortic stenosis</li> <li>◦ Coarctation of aorta</li> <li>◦ ↑ BP</li> </ul> </li> <li><b>Excessive volume</b> <ul style="list-style-type: none"> <li>◦ Aortic regurgitation</li> <li>◦ Mitral regurgitation</li> <li>◦ Ventricular septal defect</li> <li>◦ Patent ductus arteriosus</li> </ul> </li> <li><b>Disease in the myocardium</b> <ul style="list-style-type: none"> <li>◦ Ischemic heart disease &amp; myocardial infarction</li> <li>◦ Myocarditis</li> </ul> </li> </ol>
<p><b>Other causes for dyspnea</b></p>	<ul style="list-style-type: none"> <li>◦ <b>Respiratory causes:</b> obstruction to respiratory passages, COPD, pneumothorax, infections, pulmonary embolism, pleural effusion, restrictive lung disease</li> <li>◦ <b>Anemia</b></li> <li>◦ <b>Metabolic causes:</b> uremia, diabetic ketoacidosis</li> <li>◦ <b>Abdominal causes:</b> ascites</li> <li>◦ <b>Anxiety</b></li> <li>◦ <b>Poor physical fitness</b></li> </ul>

# Presentation of cardiac disease



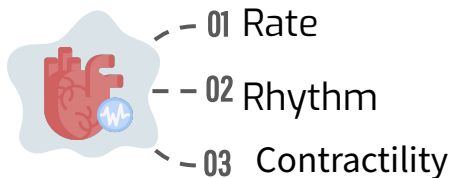
## 3- systemic venous congestion dr said: again don't worry about these (:

<p><b>Causes</b></p>	<p><b>1- Right atrium</b></p> <ul style="list-style-type: none"> <li>● Tricuspid stenosis</li> <li>● Tricuspid regurgitation</li> <li>● Right atrial tumor</li> </ul> <p><b>2- Right ventricle</b></p> <ul style="list-style-type: none"> <li>● Pressure overload</li> <li>● Volume overload</li> <li>● Myocardial damage</li> </ul> <p><b>3- Obstruction to venous inflow</b></p> <ul style="list-style-type: none"> <li>● Pericardial effusion</li> <li>● Constrictive pericarditis</li> </ul>
<p><b>Right Ventricle Failure</b></p>	<p><b>1-</b> Low cardiac output, fatigue, pale cold skin, peripheral cyanosis, rapid small volume pulse, LL edema</p> <p><b>2-</b> Blood accumulates behind the failing right ventricle → the RA → systemic veins</p> <ol style="list-style-type: none"> <li>1. Neck vein congestion</li> <li>2. Tender hepatomegaly</li> <li>3. Lower limb edema</li> <li>4. GI congestion → anorexia, nausea, flatulence</li> <li>5. Pleural effusion, pericardial effusion</li> <li>6. Ascites</li> </ol> <p><b>3-</b> Functional tricuspid regurgitation</p>
<p><b>Causes of RV Failure</b></p> <p><b>The commonest cause of RV failure is as a complication of long standing LV failure or mitral valve disease</b></p>	<p><b>1- Excessive pressure:</b></p> <ul style="list-style-type: none"> <li>○ Pulmonary stenosis</li> <li>○ Pulmonary hypertension</li> </ul> <p><b>2- Excessive volume:</b></p> <ul style="list-style-type: none"> <li>○ Tricuspid regurgitation</li> <li>○ Atrial septal defect</li> </ul> <p><b>3- Disease in the myocardium:</b></p> <ul style="list-style-type: none"> <li>○ Right ventricle infarction</li> <li>○ Myocarditis</li> </ul>
<p><b>Clinically</b></p>	<ul style="list-style-type: none"> <li>● <b>Symptoms:</b> fatigue, anorexia, nausea, abdominal distension, epigastric pain from liver congestion</li> <li>● <b>Signs:</b> edema, congested neck veins, enlarged tender liver, ascites, pleural/pericardial effusion, functional tricuspid regurgitation, cold extremities</li> </ul>

# Presentation of cardiac disease

## 4- Palpitations

Awareness of the heart beats could be due to change in:



## 5- symptoms due to low cardiac output

- Blurring of vision
- Dizziness
- Headache
- Easy fatigability
- Oliguria
- Angina pectoris

## Other modes of presentation

Symptoms	Signs
<ul style="list-style-type: none"> <li>• Fever</li> <li>• Sweating</li> <li>• Pressure symptoms</li> <li>• Embolic symptoms</li> <li>• Loss of weight</li> <li>• Easy fatigability</li> </ul>	<ul style="list-style-type: none"> <li>• Abnormal decubitus</li> <li>• Cyanosis</li> <li>• Jaundice</li> <li>• Fever</li> <li>• Clubbing</li> <li>• Edema</li> <li>• Arterial pulse, neck veins, heart sounds and murmurs</li> </ul>

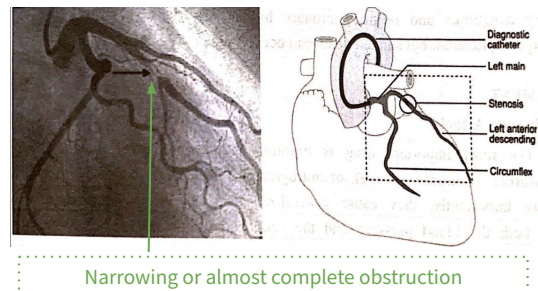
# Coronary artery bypass surgery

## Clinical syndrome of Ischemic heart disease (IHDs)

Clinical Presentation	Mechanism
<b>1. Chronic stable angina pectoris</b>	Transient myocardial ischemia during exercise.
<b>2. Acute coronary syndrome: S-T elevation acute myocardial infarction</b>	Atherosclerotic plaque disruption resulting in a total arterial occlusion with myocardial tissue necrosis. "Most life threatening and need immediate intervention "
<b>2. Acute coronary syndrome: non S-T elevation acute myocardial infarction &amp; unstable angina</b>	Plaque disruption with non-occlusive thrombus formation resulting in prolonged severe myocardial ischemia with or without foci of myocardial necrosis.
<b>3. Heart failure</b>	Loss of contractile myocardium by infarction or gradual fibrosis.
<b>4. Conduction disturbances RBBB or LBBB</b>	Necrosis, fibrosis, or edema of conduction system.
<b>5. Arrhythmias</b>	Electrical instability of ischemic myocardium.
<b>6. Sudden Death</b> "The Most common presentation of cardiovascular"	Any of the above complicated by ventricular fibrillation.

## How to approach patient with chest pain?<sup>1</sup>

- History, physical examination<sup>2</sup>
- X-ray chest, Stress ECG
- Myocardial perfusion imaging
- Dobutamine stress Echo
- Multi-slice CT with contrast
- Coronary angiography<sup>3</sup>



## Management of IHDs

- Medical treatment & control of risk factors
- Non-medical interventions (it depends on the estimation of benefit risk ratio)
  - Percutaneous coronary intervention (PCI)
  - Open heart surgery (CABG)

Single or double vessel disease, clear anatomy

### FAVOURS PCI

<b>Clinical characteristics</b>
Presence of severe co-morbidity (not adequately reflected by scores)
Advanced age/frailty/reduced life expectancy
Restricted mobility and conditions that affect the rehabilitation process
<b>Anatomical and technical aspects</b>
MVD with SYNTAX score 0-22
Anatomy likely resulting in incomplete revascularization with CABG due to poor quality or missing conduits
Severe chest deformation or scoliosis
Sequelae of chest radiation
Porcelain aorta*

Diffuse, multivessel (3 vessel) especially in presence of DM and ventricular dysfunction(it improves survival)

### FAVOURS CABG

<b>Clinical characteristics</b>
Diabetes
Reduced LV function (EF ≤35%)
Contraindication to DAPT
Recurrent diffuse in-stent restenosis
<b>Anatomical and technical aspects</b>
MVD with SYNTAX score ≥23
Anatomy likely resulting in incomplete revascularization with PCI
Severely calcified coronary artery lesions limiting lesion expansion
<b>Need for concomitant interventions</b>
Ascending aortic pathology with indication for surgery
Concomitant cardiac surgery

1- start with history and physical examination then start with the simplest investigation like chest X-ray and ECG and then you can do the more complex investigations

2- The most important

3- gold standard for diagnosis coronary artery disease



# Coronary artery bypass surgery

## Cardiac Ischemic Heart Disease Revascularization

The primary indications for surgical revascularization is to: improve the survival, improve the symptoms, and preserve the myocardium

### Indications for CABG :

1. Left main disease more than 50%
2. Left main equivalent (proximal LAD & proximal Cx more than 70%)
3. Three-vessel(RCA,LCX,LAD )disease with left ventricular dysfunction/diabetes "most common"
4. Failure of medical therapy or percutaneous intervention
5. Mechanical complications of myocardial infarction (rupture of wall of the heart, septum and chordae tendineae. tamponade. valve weakening)
6. STEMI with cardiogenic shock or on-going ischemia & PCI is not feasible
7. Associated valve disease

We classify the patient according to their lesions and according to their presentation, but if they have left main or proximal LAD >70% disease the presentation doesn't matter.

Indication	Asymptomatic or mild angina	Stable angina	Unstable angina / NSTEMI	Poor LV function
<b>Left main stenosis &gt;50% (most important vessel)</b>	Class I	Class I	Class I	Class I
<b>Stenosis of proximal LAD (most commonly affected artery in IHD) and proximal circumflex &gt; 70%</b>	Class I	Class I	Class I	Class I
<b>3 vessel disease (100% of stenosis)with LV dysfunction/Diabetes</b>	Class I	Class I	-	Class I, with proximal LAD stenosis
<b>2 vessel disease</b>	-	Class I if there is large area of viable myocardium in high-risk area	class IIb	-

- Whenever was the stenosis more proximal for example from proximal to distal (Left coronary Artery (75%)→ Left main → Left Proximal Anterior descending → Left proximal circumflex ) thats mean You need to perform CABG
- Right Coronary Artery supply 25%
- **whenever the stenosis reach 50% the CABG needs to perform, And if its lower than 50% do PCI**
- When the stenosis occurs in the middle or the end of the artery means less area will be affected, as the area affected be smaller as we use PCI instead because if the stent blocks after months it won't be a big problem.
- Proximal LAD is different from mid or distal LAD because as you go down from the artery you have less branches so the more you go down in terms of the site of stenosis the less myocardium is affected.
- **Very important:** patient with left main or proximal LAD more than 70% or 3 vessels disease go for CABG regardless of the symptoms of presentation.

# Coronary artery bypass surgery

Revascularization X = no, ✓ = yes, C = needs consultation	CABG			DES (drug eluting stent) Other name for PCI (percutaneous Coronary intervention)		
	No-risk	DM	LVD	No-risk	DM	LVD
<b>LMC</b> (left main coronary vessel) +/- other lesions	✓	✓	✓	X	X	X
<b>3 vessel + proximal LAD</b>	✓	✓	✓	X	X	X
<b>3 vessel</b>	✓	✓	✓	C	C	C
<b>2 vessel + proximal LAD</b>	✓	✓	✓	X	X	X
<b>2 vessel with LAD</b>	✓	✓	✓	✓	✓	✓
<b>2 vessel without LAD</b>	X	X	X	✓	✓	✓
<b>Proximal LAD</b> (50% of supply)	✓	✓	✓	X	X	X
<b>1 vessel</b> (lower than 50% of supply? Then PCI)	X	X	X	✓	✓	✓

- We classify double-vessel based on the involvement of LAD and if it's proximal or not (2 vessels with proximal LAD=CABG, while 2 vessel with distal LAD is the same as no LAD = no CABG)
- Dr: I just want you to know the intervention DES & CABG and what are the indications for each
- To remember it in a simple way, think of the most important vessels (always CABG):
  - The most important is **LMC** (Left main coronary artery)
  - The second most important are **LMC equivalents (proximal LAD or LCX)**
  - The third most important if **3 vessels** are affected
  - The rest is any disease affect **proximal LAD**

- A vascular graft is sutured to the coronary artery beyond the stenosis
- Improves blood flow to the heart.

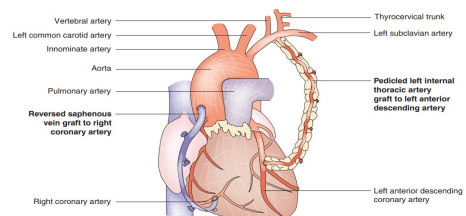
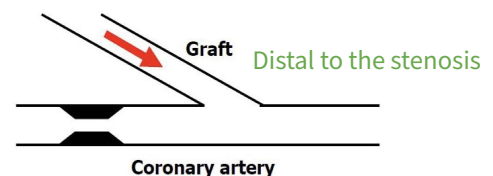


Fig. 22.7 Completed coronary bypass procedure with venous and left internal thoracic artery grafts in situ.

## A Visual Representation of CABG:

CABG and DES (PCI) depend on the percentage of blood supply if its **more than 50%? Do CABG, Lower than 50%? Do DES (PCI)**



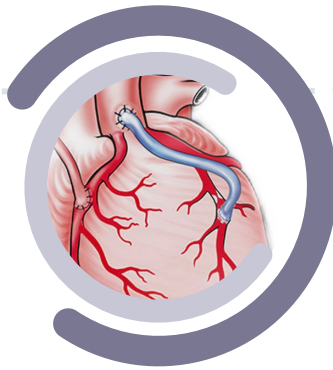
# Coronary artery bypass surgery



## Coronary Conduits for CABG:

### Venous

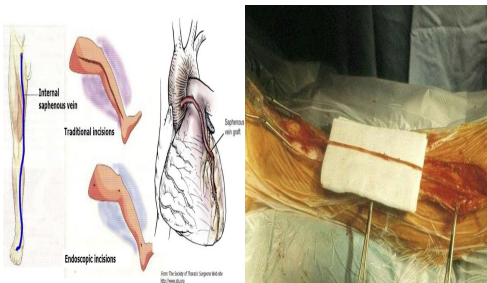
- **Great saphenous vein** with antiplatelets, statins It gives a better outcome has patency rates of around 70% at 5 years
- Short saphenous vein (rarely used)



### Arterial

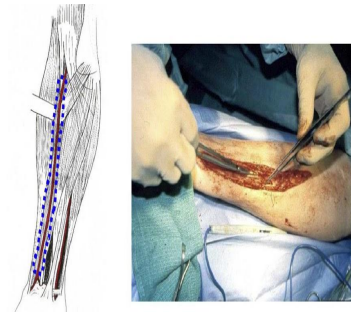
- ★ **Internal thoracic artery**
  - (internal mammary artery) It has a very high graft patency exceeds 95% at 5 years
- **Left internal mammary A.**
- **Right Internal mammary A.**
- **Radial A.**
- Right gastroepiploic A. (rarely used)

#### Long saphenous vein



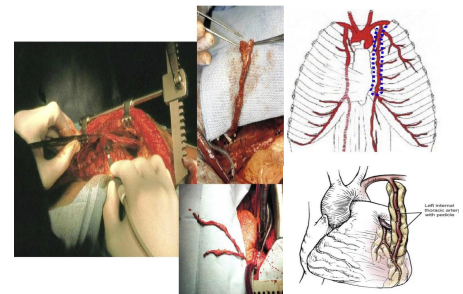
Extra(Previous slides )

#### Radial artery



Radial artery Make sure that it is not the patient's dominant artery by doing (Allen's test)

#### Internal thoracic artery



Originate from subclavian artery You separate it from the chest wall and do only one anastomoses



## Type of surgery:

1. Conventional (on pump): using the heart-lung machine, and cardioplegic arrest
2. Off-pump (beating heart surgery)

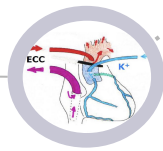
Without pump	With pump
<ul style="list-style-type: none"> <li>• Don't use the lung heart machine they stabilize the part of the heart they working on with devices called the octopus</li> </ul>	<ul style="list-style-type: none"> <li>• Bypass the lung and the heart using the heart lung machine stop the heart do the bypass then resume the systemic (normal) circulation</li> </ul>



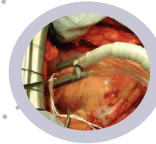
# Coronary artery bypass surgery

## Under ECC with cardioplegia

- Drain the heart
- The blood get oxygenated in the machine and returns to the aorta



## CABG Operative Technique



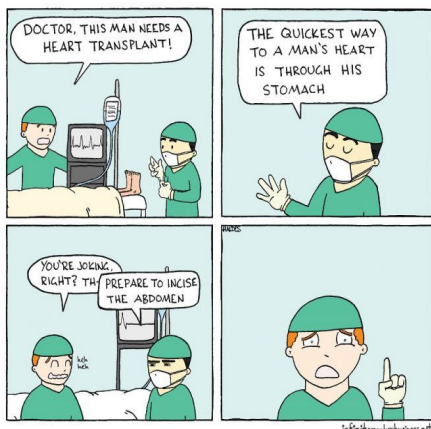
## Beating heart surgery (without ECC " without extracorporeal circulation")

- Stabilizer around the coronary artery



## Benefits of Off-Pump CABG : (it's better than the ones with pump)

- ↓ Incidence of stroke & cognitive problems (machine ↑ risk of microthrombi)
- ↓ Renal dysfunction
- ↓ Inflammatory response (elderly can't tolerate the inflammatory response associated with the pump)
- ↓ Coagulopathy requirements of blood transfusion and less bleeding
- ↓ Length of time in intensive care & hospital stays
- ↓ Morbidity & mortality rates



# Valvular Heart Disease

## Clinical Evaluation of a Patient With Valvular Heart Disease:

1. Correctly diagnosing the affected valve(s)
2. Estimating the severity of the lesion
3. Judging its effect on the myocardium
4. Deciding on the need for infective endocarditis prophylaxis
5. Deciding on the timing of surgery/catheter-based intervention

## General Notes from Dr. Turki team 441 & 442

- **For your level I want you to remember that we send patient to surgery if:**
  - Symptomatic
  - LV dilation ( Exclude it in Mitral stenosis only )
  - LV dysfunction ( Exclude it in Mitral stenosis only )
  - Pulmonary hypertension
  - Atrial fibrillation
- LV dysfunction and dilatation is **Class I** indication
- Pulmonary hypertension and atrial fibrillation are **Class II** indication for all valvular diseases
- We have 20 techniques for valve repair, I just want you to know when to send a patient to surgery and determine whether repair or replacement:
  - **Valve replacement:** mainly for aortic stenosis, regurgitation, and mitral regurgitation
  - **Valve repair:** mitral stenosis and regurgitation
  - **Valvuloplasty:** mitral stenosis

## Mitral Stenosis:

<b>Etiology</b>	<ul style="list-style-type: none"> <li>• Rheumatic most common cause</li> <li>• Congenital</li> <li>• LA myxoma the most common tumor in the heart that obstructs the valve</li> </ul>
<b>Prognosis</b>	<ul style="list-style-type: none"> <li>• The natural progression of MS causes the MV area to reduce by 0.1 - 0.3 cm per year</li> <li>• The progression from the onset of rheumatic fever to onset of signs of MS takes 10-20 y</li> <li>• The progression from signs of MS to mild symptoms of MS takes 10-20 years</li> <li>• The progression from mild symptoms to decompensation takes 10-20 years</li> <li>• In patients with severe PH the mean survival is 3 years</li> </ul>

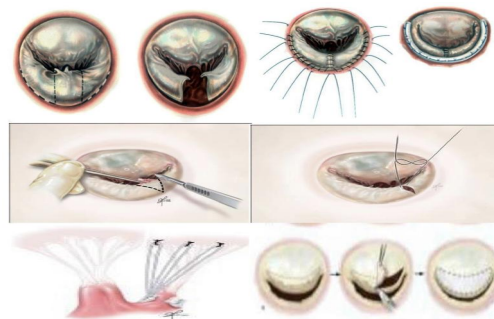
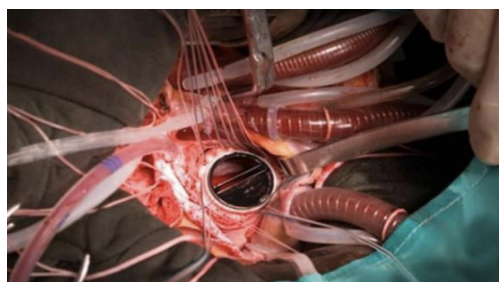
- Some patients afraid of surgeries so they lie about their history so how to catch them? do an **echo**, and look if they are **symptomatic** or not, then do a **stress test** after these go back to five things that we for surgeries Atrial fib.... etc



## Mitral Stenosis Cont...:

<b>Symptoms</b>	<ul style="list-style-type: none"> <li>● Asymptomatic for many years</li> <li>● Symptoms of pulmonary congestion</li> <li>● Palpitations</li> <li>● <b>Dysphagia, compression of left main bronchus</b></li> <li>● Symptoms of low cardiac output</li> </ul>
<b>Signs</b>	<ul style="list-style-type: none"> <li>● <b>Pulse:</b> low volume, irregular</li> <li>● <b>Apex beat:</b> tapping non-displaced imp to distinguish whether the apex is displaced or not.</li> <li>● <b>Auscultation:</b> loud S1, mid-diastolic rumbling murmur</li> <li>● <b>Signs of pulmonary hypertension:</b> central cyanosis, Loud P2, T.R. P.R.</li> </ul>
<b>Treatment</b>	<ul style="list-style-type: none"> <li>● <b>Medical:</b> for mild cases</li> <li>● <b>Surgical (indications): Symptomatic patients, Pulmonary HTN, &amp; Afib</b> <ul style="list-style-type: none"> <li>○ Asymptomatic pts with severe MS (<b>valve area &lt; 1.0 cm<sup>2</sup></b>) and in those with severe MS and new onset Afib, severe MS undergoing cardiac surgery for other primary indications</li> <li>○ Symptomatic pts (NYHA class III or IV) with moderate or severe MS (an echocardiographic calculated <b>mitral valve area &lt; 1.5 cm<sup>2</sup></b>)</li> <li>○ Evidence of a LA thrombus, recurrent emboli or development of pulmonary hypertension (PAP &gt; 50 mmHg) &gt; 60</li> <li>○ Mitral valve surgery for MS is recommended for symptomatic severe MS when the valve is not favorable for percutaneous balloon commissurotomy (presence of LA clot, significant MR)</li> <li>○ Surgery for severe cases EXCEPT in bulging valve, calcified valve, MR over MS</li> <li>○ No LV dysfunction or dilation because it's mitral stenosis.</li> </ul> </li> </ul>

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
PMC is recommended in symptomatic patients without unfavourable characteristics <sup>c</sup> for PMC. <sup>360,363–365,367</sup>	I	B
PMC is recommended in any symptomatic patients with a contraindication or a high risk for surgery.	I	C
Mitral valve surgery is recommended in symptomatic patients who are not suitable for PMC in the absence of fertility.	I	C
PMC should be considered as initial treatment in symptomatic patients with suboptimal anatomy but no unfavourable clinical characteristics for PMC. <sup>c</sup>	IIa	C
PMC should be considered in asymptomatic patients without unfavourable clinical and anatomical characteristics <sup>c</sup> for PMC and: <ul style="list-style-type: none"> <li>● High thromboembolic risk (history of systemic embolism, dense spontaneous contrast in the LA, new-onset or paroxysmal AF), and/or</li> <li>● High risk of haemodynamic decompensation (systolic pulmonary pressure &gt;50 mmHg at rest, need for major NCS, desire for pregnancy).</li> </ul>	IIa	C





## Mitral Stenosis Cont...:

<p><b>Treatment</b> (continued)</p>	<p><b>Procedures:</b> For mitral stenosis we only do replacement or valvuloplasty .</p> <p>1- Balloon mitral valvuloplasty: method of choice when the stenosis is mainly due to fusion of the valve cusps; in patients with a pliable valve <b>with no evidence of LA clot or MR + calcifications. First line therapy</b></p> <p>2- Closed mitral commissurotomy: supplanted by PBMV; not performed anymore</p> <p>3- Open mitral commissurotomy: separation of the fused leaflets, and reconstruction of the valve in some younger patients, permitting more extensive surgery under direct visualization. If PBMV is not feasible or there is associated LA thrombus.</p> <p>4- Valve replacement/repair: if the leaflets are <b>calcified and fibrotic</b> (extensive leaflet calcification, with involvement of the subvalvular apparatus). There is shortening and thickening of the papillary muscles and chordae tendineae, tethering the leaflets to the tips of the papillary muscles. Mitral valve replacement should be performed in patients in whom mitral valve repair is not suitable (e.g., extensive valve destruction from endocarditis, severe leaflet calcification and fibrosis from rheumatic heart disease, or select patients with ischemic cardiomyopathy).</p> <p>5- Trans-catheter: valve-in-valve procedures to treat bio-prosthetic MS or MR is still in its infancy.</p>
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## Mitral Regurgitation:

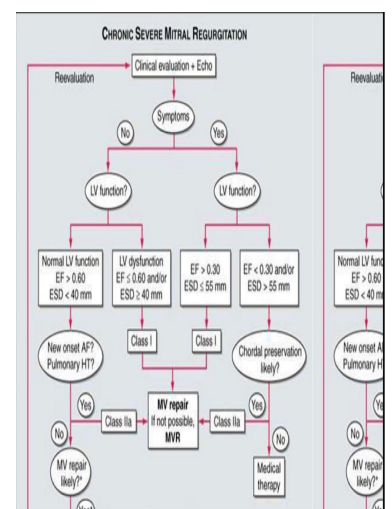
<p><b>Definition</b></p>	<p>Retrograde (backward) flow of blood from the LV into the LA due to impaired systolic coaptation between the anterior and posterior leaflets.</p>
<p><b>Etiology</b></p>	<ul style="list-style-type: none"> <li>● Rheumatic <b>most common cause</b>, degenerative, endocarditis</li> <li>● Dilatation of the LV &amp; mitral valve ring.</li> <li>● Dysfunction of the papillary muscle.</li> <li>● Congenital abnormalities.</li> <li>● Calcification of the mitral valve annulus.</li> </ul>





## Mitral Regurgitation Cont....:

<b>Symptoms</b>	<ul style="list-style-type: none"><li>● <b>Asymptomatic patients:</b> can have a long latent period before the onset of symptoms as chronic MR is well tolerated if LV function is still preserved</li><li>● <b>Symptoms of MR:</b> fatigue, weakness, dyspnea, orthopnea, PND, pulmonary hypertension (low cardiac output, congestive HF (LL edema, congested neck veins, enlarged tender liver))</li></ul>
<b>Signs</b>	<ul style="list-style-type: none"><li>● <b>Apex beat:</b> displaced + apical thrill</li><li>● <b>Auscultation:</b> apical pansystolic murmur</li><li>● Signs of pulmonary hypertension</li></ul>
<b>Treatment</b>	<ul style="list-style-type: none"><li>● <b>Medical:</b> in acute MR temporarily while surgery is planned. In chronic MR to optimize cardiac function but surgery is the definitive treatment.</li><li>● <b>Surgical (indication):</b> depending on LV dimensions &amp; functions<ul style="list-style-type: none"><li>○ Prompt MV surgery is indicated for symptomatic pts with acute severe primary MR (<b>IMP</b>)</li><li>○ In chronic MR, surgery is done for symptomatic or asymptomatic pts with evidence of LV dysfunction (EF &lt; 60%, LVESD &gt; 40 mm, new onset AF, or pulmonary hypertension) (<b>IMP</b>)</li><li>○ Asymptomatic pts with chronic severe MR &amp; preserved LV (EF &gt; 60%, ESD &lt; 40 mm) in experienced centers with likelihood of repair &gt;90%, 95% sometimes an asymptomatic patient may undergo mitral valve replacement surgery to prevent further complications</li></ul></li><li>● <b>Surgical procedures:</b><ul style="list-style-type: none"><li>○ Mitral valve repair: preferred over replacement if a successful &amp; durable repair can be achieved we have to try repair first because its outcomes are better</li><li>○ Mitral valve replacement</li><li>○ Percutaneous approaches to MR continue to evolve and appear to be applicable to patients with degenerative and functional MR</li></ul></li><li>● The same indication as AS/AR but the difference is in the numbers (the number of ejection fraction considered for surgery in MR in less than 60 and end-systolic dimension more than 40)</li></ul>



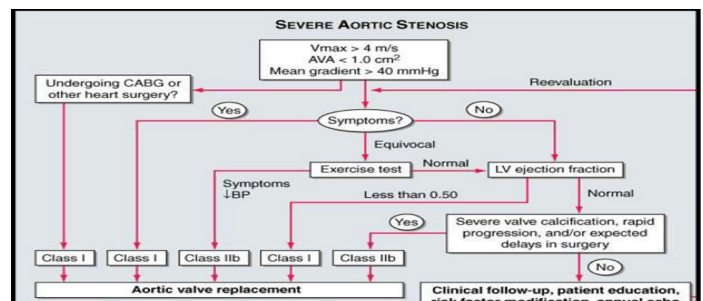




# Aortic Stenosis:

<p><b>Etiology</b></p>	<ul style="list-style-type: none"> <li>● Rheumatic: common in underdeveloped countries</li> <li>● Congenital: a congenital bicuspid valve calcifies at an earlier age</li> <li>● Degenerative: calcific AS; most frequent etiology in the Western world</li> </ul>
<p><b>Symptoms</b></p>	<ul style="list-style-type: none"> <li>● Chest pain (effort angina)</li> <li>● Syncopal attacks</li> <li>● Dyspnea &amp; CHF</li> <li>● The interval from onset of symptoms to death tends to be: 2 years for CHF, 3 years for syncope, and 5 years for angina → Triad of symptoms</li> <li>● The ventricle will be hypertrophied and then dilate trying to accommodate the volume and eventually develop L.V dysfunction</li> <li>● When the back pressure reaches the atrium it will dilate → stretch on fibers → Afib</li> </ul>
<p><b>Signs</b></p>	<ul style="list-style-type: none"> <li>● <b>Pulse:</b> slow-rising, small amplitude (pulsus parvus and tardus) → late (tardus) and weak/small (parvus)</li> <li>● <b>Apex beat:</b> sustained</li> <li>● <b>Auscultation:</b> harsh ejection systolic murmur heard in the right second intercostal space; aortic component of S2 is soft</li> </ul>
<p><b>Treatment</b></p>	<ul style="list-style-type: none"> <li>● <b>Medical:</b> treat the symptoms</li> <li>● <b>Surgical (indications): IMP</b> <ul style="list-style-type: none"> <li>○ Patients with severe symptomatic AS (IMP)</li> <li>○ Asymptomatic patients with moderate or severe as undergoing cardiac surgery for coronary or other valve disease</li> <li>○ Asymptomatic patients with severe AS and reduced EF (&lt; 50%)</li> </ul> </li> <li>● <b>Procedures: IMP</b> <ul style="list-style-type: none"> <li>○ <b>Surgical aortic valve replacement (AVR):</b> mostly used via femoral artery; low to moderate surgical risk, higher surgical risk AND severe multivessel CAD</li> <li>○ <b>Transcatheter aortic valve implantation (TAVI):</b> via femoral artery, for patient who have contraindication or high risk for surgery. In some patients, e.g. the elderly, those with patent coronary grafts or significant other comorbidities</li> <li>○ <b>Percutaneous balloon valvuloplasty:</b> indicated in children, adolescents, and young adults without AV calcification</li> </ul> </li> </ul>

- Class I:**
1. Patient undergoing CABG.
  2. Symptomatic.
  3. LVEF < 50%.
- Class IIb:**
1. Symptomatic/ decreased BP on exercise test.
  2. Severe valvular calcification progression.
- Two Interventions:**
1. Surgery (Valvular replacement).
  2. Catheter (via femoral artery) → Why isn't done that much?
  - a. Because the opening for the coronaries might get blocked.
  - b. valvular leakage.
  - c. risk for stroke due to emboli (10g Ca+2) → only done when the patient is at high risk in surgery.





# Aortic Regurgitation:

## Definition

- AR is the diastolic reflux of blood from the aorta into the LV due to failure of coaptation of the valve leaflets at the onset of diastole; it can be acute or chronic
- Stenosis starts with dysfunction (due to pressure overload) than dilatation while regurge starts with dilatation (due to volume overload) than dysfunction
- Why is this important? Dysfunction in stenosis patient in early stage so they will have favorable outcome from surgery (the same applies to regurge patient with dilatation)

## Etiology

Rheumatic, endocarditis, connective tissue disorders, aortic dissection or aneurysm

## Symptoms

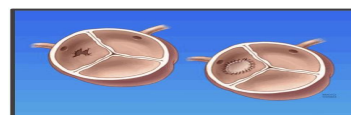
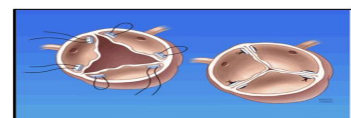
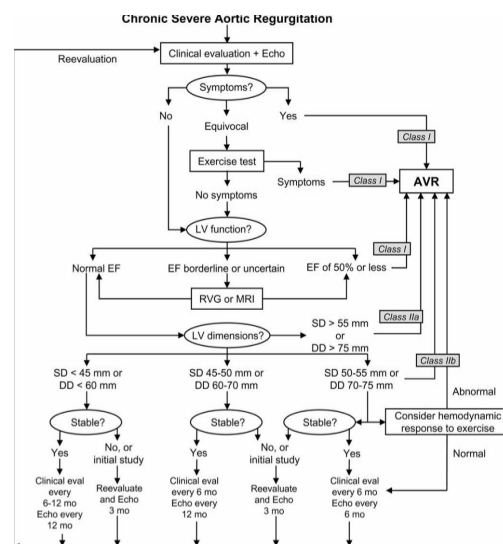
- Asymptomatic
- Palpitations due hyperdynamic LV contraction (IMP)
- LV failure: dyspnea, orthopnea, PND
- Angina in severe cases only
- Aortic dissection should be suspected in any patient presenting with angina and recent onset AR**
- Acute AR** produces severe dyspnoea, with rapid onset of LV failure and pulmonary oedema require emergency ventilation and urgent surgery
- Chronic AR** is well tolerated and often asymptomatic. In severe cases, the patient may complain of dyspnoea and angina, and may exhibit features of congestive cardiac failure

## Signs

- Pulse:** wide pulse pressure, collapsing
- Apex beat:** hyperdynamic displaced
- Auscultation:** early diastolic murmur in the left parasternal area
- Peripheral signs of AR
- Generalized vasodilation resulting in warm hands & feet + increased sweating

## Treatment

- Surgical (indications):**
  - Acute AR:** management is by early surgery
- Acute aortic regurgitation produces severe dyspnoea, with rapid onset of LV failure and pulmonary oedema require emergency ventilation and urgent surgery.
- Chronic AR:** current recommendations for management depend on the presence of symptoms, LV function, and LV dimensions
  - Symptomatic patients with severe AR regardless of LV function
  - Asymptomatic patients with chronic severe AR & resting EF < 55%
- AVR** is reasonable for asymptomatic patients with severe AR with normal LV systolic function but with severe LV dilatation (LVESD > 50mm) (LV end diastolic dimension > 70 mm and end systolic dimension > 50 mm)
- Procedures:** Aortic valve replacement (AVR) OR repair.
- The difference in physiology is that stenosis starts with dysfunction (due to pressure overload) than dilatation while regurge starts with dilatation (due to volume overload) than dysfunction.
- Why is this important? Dysfunction in stenosis patient in early stage so they will have favorable outcome from surgery (the same applies to regurg patient with dilatation)
- Indications of AS are the same as AR but the difference is in the physiology



# Valvular Prostheses





## Overview of AVR Options:

Prosthesis	Description	Advantages	Disadvantages	Lifespan
Mechanical	Bileaflet	Best durability	Anticoagulation	Lifetime
Stented bio prosthesis	Porcine/ bovine pericardial	No anticoagulation	Durability	10-15 years
Homografts/ autografts	Human aortic valve	No anticoagulation, excellent dynamics	Technical complexity	-

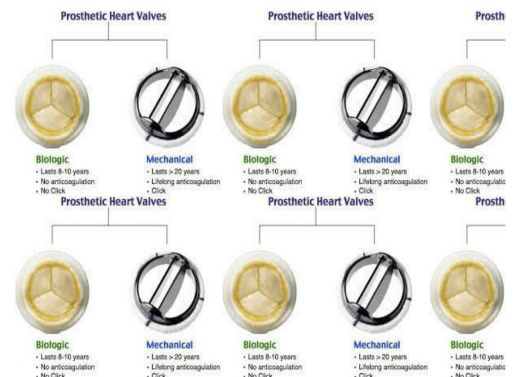


## Valvular Prostheses:

Mechanical (Metallic) 	Biologic (Bioprosthetic Valve) Tissue Valve 
<ul style="list-style-type: none"> <li>• Lasts &gt; 20 years.</li> <li>• Lifelong anticoagulants.</li> <li>• Click:</li> <li>• Unless there is contraindication to anticoagulation, mechanical valves are commonly used in younger age group → because we don't want to perform a surgery every 8-10 years in a young patient.</li> </ul>	<ul style="list-style-type: none"> <li>• Lasts 8-10 years.</li> <li>• No anticoagulants.</li> <li>• No click:</li> <li>• We use biological valve for old age and contraindication for anticoagulant like in female childbearing age → since the younger age patients tend to have more immunity, inducing inflammatory response, leading to valve dysfunction.</li> </ul>

### Complications of Prosthetic Valves:

- 1- Thrombosis, especially in mechanical valve.
- 2- Bleeding complications (Anticoagulant related)
- 3- Infective endocarditis in some cases of endocarditis prophylactics are needed.
- 4- Para- valvular leak
- 5- Degeneration of biological valves



# Infective Endocarditis

## Overview

- Infective endocarditis is an infection of cardiovascular structure including valves and intra-cardiac foreign bodies as pacemaker leads, prosthetic valves and surgical patches.
- It most commonly occurs at sites of previous endocardial damage caused by high pressure jets of blood.
- Endocarditis of the tricuspid valve occurs in I.V. drug abusers.
- Some people got IE because their valve is affected.

## Modified Duke Criteria

**A definitive clinical diagnosis can be made on the following:**  
2 major criteria, 1 major and 3 minor, or 5 minor criteria



## Microbiological evidence

- Typical microorganisms consistent with IE from 2 separate blood cultures.
- Persistently positive blood cultures with other organisms:
  - At least 2 +ve cultures drawn >12 hours apart
  - All 3 or majority of 4 separate cultures with the first and last at least 1 hour apart
  - Single +ve culture for *Coxiella burnetii*

## Major Criteria

## Evidence of endocardial involvement



- Oscillating intracardiac mass
- Abscess
- New partial dehiscence of prosthetic valve
- New valvular regurgitation



## Treatment:

See next slide for indications for surgery

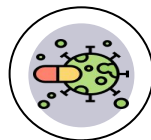
### 3 Steps involved:

1. Diagnosis of IE based on Dukes Criteria.
2. Determine if the patient needs surgery or not. Is it urgent or not?
- 3.



## What to choose?

Not all patients with endocarditis will need surgery, some will be treated by medications.



## Antibiotics

Course of antibiotics (Right valves 2w, left valves 6w)



## Surgery

When do we decide that this patient needs surgery? If he has an affected valve.



## Infective Endocarditis:

Indications for and Timing of Surgery In Patient With Left-Sided Native Valve Infective Endocarditis	
Indication	Timing of surgery
<b>Uncontrolled Heart Failure</b> <small>Not responding to medication</small>	
<b>Aortic or mitral valve infective endocarditis with severe acute regurgitation or obstruction causing refractory pulmonary edema or cardiogenic shock</b>	<b>Emergency</b>
Aortic or mitral valve infective endocarditis with fistula into a cardiac chamber or pericardium causing refractory pulmonary edema or cardiogenic shock	Emergency
Aortic or mitral valve infective endocarditis with severe acute regurgitation or obstruction and persistent heart failure ( <b>not responding to therapy</b> ) or signs of poor hemodynamic tolerance ( early mitral valve closure or pulmonary hypertension)	Urgent
Aortic or mitral valve infective endocarditis with severe regurgitation and heart failure easily controlled with medical treatment	Elective
<b>Uncontrolled Infection</b>	
Locally uncontrolled infection ( <b>abscess</b> , false aneurysm, fistula, enlarging vegetation, or dehiscence of prosthetic valve)	<b>Urgent</b>
Persistence fever and positive blood cultures for >5-7 days	Urgent
Infection caused by fungi or multidrug-resistant organisms, such as <i>Pseudomonas aeruginosa</i> and other gram-negative bacilli	Elective
Lack of response to antibiotics (repeat the culture, if shown that you are using the right antibiotic and there is no response do surgery)	-
<b>Prevention of Embolism</b>	
Aortic or mitral valve infective endocarditis with <b>large vegetation</b> (>10 mm in length) after one or more embolic episode, despite appropriate antibiotic therapy, especially during the first 2 weeks of therapy	<b>Urgent</b>
Aortic or mitral valve infective endocarditis with large vegetation ( <b>&gt;10 mm in length</b> ) and other predictors of complicated course ( <b>heart failure, persistence infection with staph aureus or fungal, or abscess</b> ) most likely they will not respond to antibiotics. if they respond well it will be recurrent again even if the valve is still normal	<b>Urgent</b>
Isolated, <b>very large vegetation</b> (>15mm) : surgery may be preferred if a procedure preserving the native valve is feasible	Urgent
Re-embolism on treatment because he is not responding to treatment.(embolism it self is not an indication for surgery it should be a (re-embolism) the embolism should happen after the treatment	-



# Arrhythmia



1. **Investigate:** investigate for the reason, and correct it
2. **Medical:** first line of treatment is medical therapy
3. **Catheter:** if pt didn't respond to medical therapy and has no other cardiac problems expect arrhythmia we may do ablation by cath
4. **Surgery:** if cath failed or the pt already has another indication for surgery coexisting with arrhythmia we perform the surgery and do ablation via surgery. Success rate for cath is 30%-60%, while success rate for surgery is 70%-90%; but we don't open a patient's chest for just AF

Recommendations	Class	Level
<b>Surgical ablation of AF should be considered in patients with symptomatic AF undergoing cardiac surgery</b>	<b>IIa</b>	<b>A</b>
<b>Surgical ablation of AF may be performed in patients with asymptomatic AF undergoing cardiac surgery if feasible with minimal risk</b>	<b>IIb</b>	<b>C</b>
Minimally invasive surgical ablation of AF without concomitant cardiac surgery is feasible and may be performed in patients with symptomatic AF after failure of catheter ablation	<b>IIb</b>	<b>C</b>

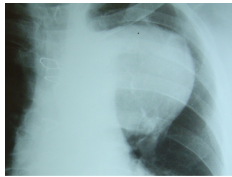
# Thoracic Aortic Diseases



Thoracic Aortic Aneurysm	Aortic Dissection
Aneurysm is a localized or diffuse dilatation of a vessel wall more than 1.5 the normal diameter.	It's a tear in the intima allowing blood to enter and flow in a false channel. there are 2 lumens separated by the dissecting membrane



# Aortic Aneurysm

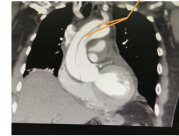
<b>Definition</b>	<p>A localized or <b>diffuse dilatation of a vessel wall</b> more than 1.5 the normal diameter. (definition of aneurysm: doubling the size of the aorta, but the indication of intervention is when it meets the criteria)</p>
<b>Clinical Features</b>	<ul style="list-style-type: none"> <li>• Symptoms &amp; signs of an aneurysm arise from:             <ol style="list-style-type: none"> <li>1. Compression of surrounding structures</li> <li>2. Erosion of surrounding bone</li> <li>3. Rupture or leakage of blood</li> </ol> </li> <li>• Its manifestations depend on the site of the aneurysm.</li> </ul>
<b>Aneurysm of The Ascending Aorta</b>	<p>this is called aneurysm of the signs as it produces many signs and few symptoms:</p> <ol style="list-style-type: none"> <li>1- the aneurysm produces dullness and palpable pulsations in the second right intercostal space</li> <li>2- compression and obstruction of the superior vena cava result in dilated non- pulsating neck veins and congestion of the face, arms and chest.</li> <li>3- compression of the right bronchus and lung causes collapse.</li> <li>4- erosion of the sternum may produce a pulsating mass</li> <li>5- cardiac signs:             <ul style="list-style-type: none"> <li>- Aortic regurge</li> <li>- LV enlargement from aR</li> </ul> </li> </ol>
<b>Aneurysm of The Aortic Arch</b>	<p>This is called aneurysm of symptoms:</p> <ol style="list-style-type: none"> <li>1- compression of the trachea results in cough, dyspnea, hoarseness of the voice</li> <li>2- compression of the esophagus results in dysphagia</li> <li>3- compression of RLN produces hoarseness of voice</li> <li>4- pressure on the arteries leads to unequal pulses</li> <li>5- erosion of the vertebrae causes deep-seated pain in the back</li> </ol> 
<b>Treatment</b> <b>2</b> <b>Interventions:</b> <b>Endovascular and Open surgery</b>	<ul style="list-style-type: none"> <li>• The absolute criteria for aortic aneurysm: we operate if the aneurysm reaches             <ul style="list-style-type: none"> <li>○ <b>Ascending aorta &gt; 5.5 cm</b></li> <li>○ <b>Arch of the aorta &gt; 5.5 cm</b></li> <li>○ <b>Descending aorta &gt; 5.5 cm</b></li> </ul> </li> <li>• This criteria applies applies for :             <ol style="list-style-type: none"> <li>1. Asymptomatic (if they have symptoms, don't wait for the criteria to operate). Usually the symptoms come from distention (pressure at the wall) which comes from high BP so if you treat the BP they will become asymptomatic (eg: you started a patient with symptomatic aneurysm on meds that decreases their BP. If the patient is okay after the meds, they get sent home and followed up. If not okay, we still operate on them even though they didn't meet the criteria).</li> <li>2. Low risk patient (indication will be less in high risk patients)</li> </ol> </li> <li>• <b>Not all patients are the same:</b> we treat each patient depending on his age, height, and morbidity (<b>bicuspid valve, connective tissue disease, Marfan's syndrome</b>). <b>Certain patients are called high-risk patients (we operate on them in 0.5 cm smaller).</b></li> <li>• <b>High risk patients are patients with: Marfan's syndrome, bicuspid valve, familial aneurysmal disease, dissection patients, &amp; connective tissue disease.</b></li> <li>• Rate of growth criteria: if the aneurysm is 4 cm I have to send him for another CT in 6 months. Normal rate of growth is 0.1 cm per year, rapid rate of growth &gt; 0.5 cm per year.</li> <li>• Coexisting surgery is an indication to decrease our limits (same concept applied to all cardiac surgeries)</li> <li>• Commonly accepted criteria for surgical intervention on ascending aortic aneurysm:             <ul style="list-style-type: none"> <li>○ <b>Sporadic:</b> &gt; 5.5 cm</li> <li>○ <b>Connective tissue disorders:</b> 4.5-5 cm</li> <li>○ <b>Bicuspid aortic valve:</b> 5 cm</li> <li>○ <b>Concomitant cardiac surgery:</b> &gt; 4.5 cm</li> <li>○ <b>Growth of aneurysm:</b> &gt; 0.5 cm/year</li> <li>○ <b>Symptoms due to the aneurysm</b></li> </ul> </li> </ul>

# Aortic Disease

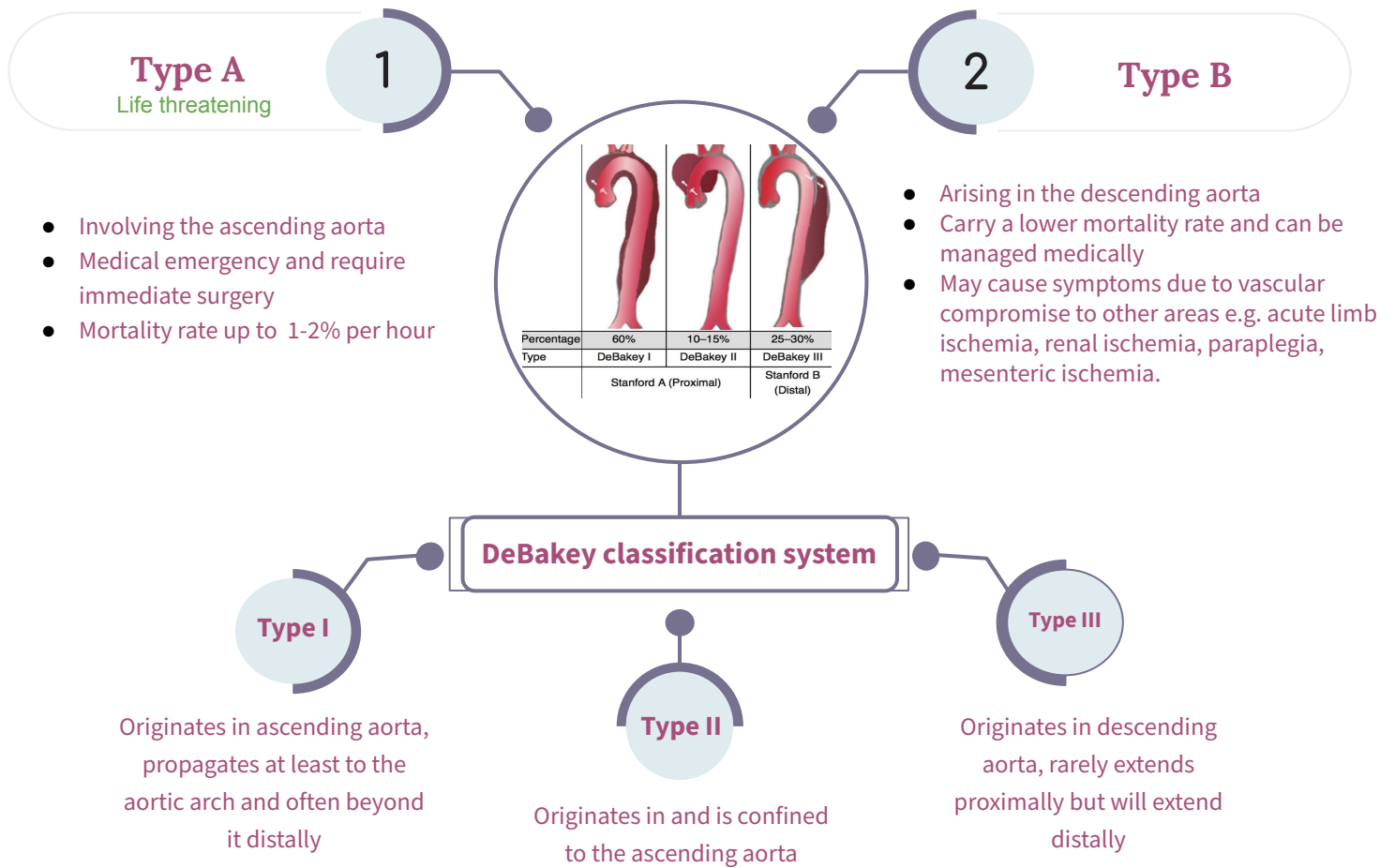


## Aortic dissection

Aortic Dissection



- **Aortic dissection:** Tear in the intima allowing blood to enter and flow in a false channel. There are 2 lumens separated by the dissecting membrane
- ★ Sudden onset of “ knife like “ pain in the chest radiating to the back and epigastric region



- **Daily (Stanford) classification system:** Divided into 2 groups; A and B depending on whether the ascending aorta is involved
  - **A** = Type I and II DeBaakey
  - **B** = Type III DeBaakey







## Clinical Picture Female Dr skipped this

- Pain: very sudden onset with severe tearing retrosternal pain that resembles that of myocardial infarction but radiates to the back, neck, abdomen and legs.
- Aortic regurgitation in some cases.
- Involvement of great vessels produces unequal pulses, neurologic signs, renal pain, paraplegia etc.
- Left side pleural effusion
- Involvement of RCA leads to ischemic pain or M.I.
- The patient is usually hypertensive.



## Differential Diagnosis

"this is very important because the No.1 contraindication for someone with Aortic Dissection is to give them thrombolytics"

- Aortic dissection is most commonly confused with M.I.
- It can be differentiated from it by :
  - a) The pain is of very abrupt onset and radiates to the back and abdomen.
  - b) Presence of unequal upper limb pulses or weak femoral pulses. radio-radial delay
  - c) Presence of aortic regurgitation
  - d) Wide mediastinum in the chest x-rays



# Heart Failure



- In some cases of reduced ejection fraction everything seems to be normal and refractory to medical treatment, so we move to an advanced therapy:
  - **Cardiac resynchronization therapy** because RV & LV don't contract at the same time
  - if he relapses so we implant **ventricular assist device** or **transplant heart** depend on the indications



## Heart Transplant:

**End-Stage HF?** if we have a heart? do **Transplant**  
if we didn't? do **ADVANCED MECHANICAL ASSISTANCE**

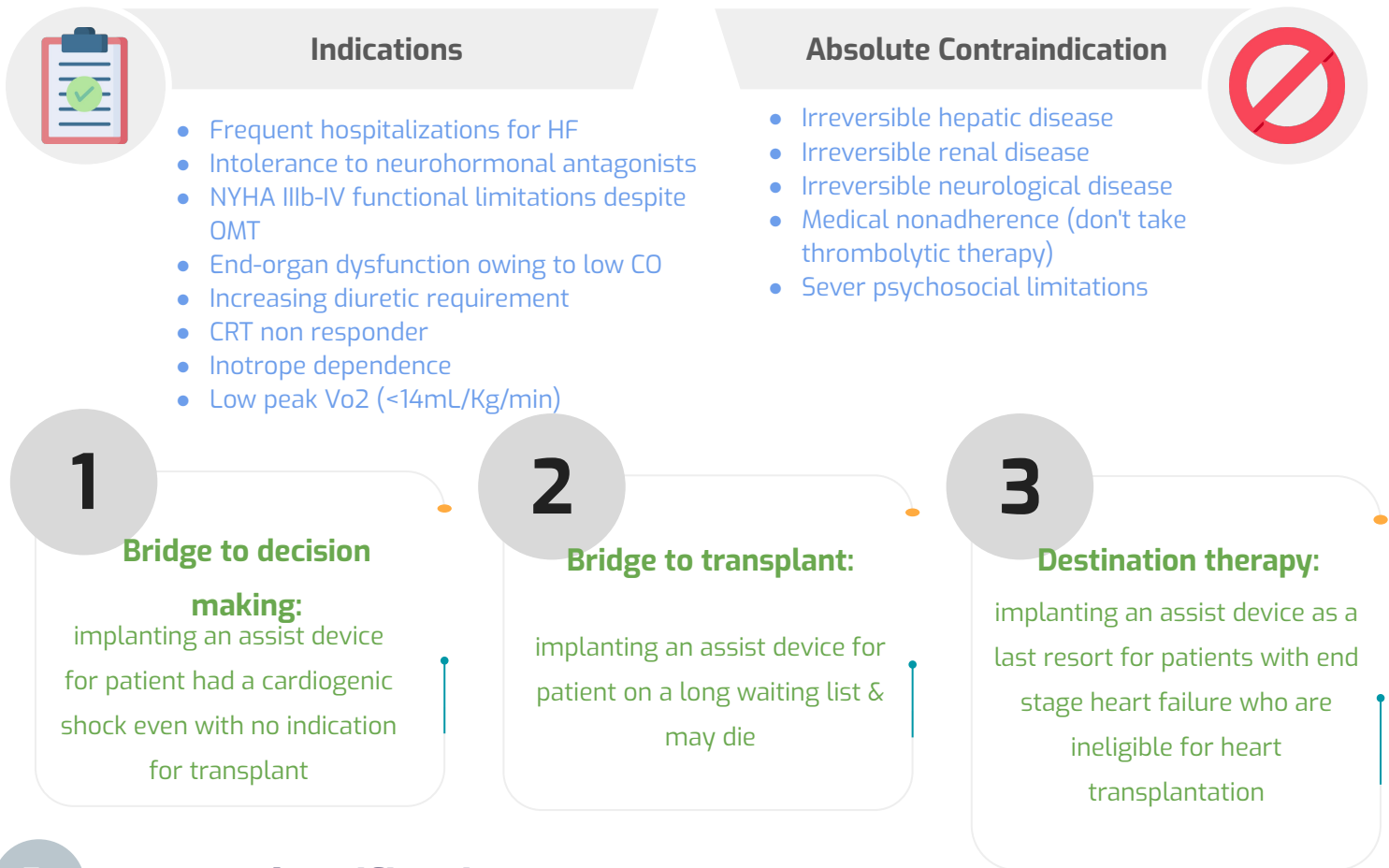
Indications	Absolute Contraindication
Cardiogenic shock requiring mechanical assistance=Medications didn't work	<b>Pulmonary hypertension</b> (TPG "transpulmonary gradient" > 15 mmHg, SPAP "systolic pulmonary pressure" > 50 mmHg, PVR "pulmonary vascular resistance" > 4 WU, PVRI "pulmonary vascular resistance index" >6) because they will have acute RV failure
Refractory heart failure with continuous inotropic infusion.	Diabetes mellitus with end organ damage
NYHA functional class 3 and 4 with a poor 12 months' prognosis	Elevated creatinine (>200 umol/L).
Progressive symptoms with maximal therapy	Psychosocial (substance abuse, smoking, medical noncompliance)
Severe symptomatic hypertrophic or restrictive cardiomyopathy	Active infection
Medically refractory angina with unsuitable anatomy for revascularization	Malignancy (within 5 years)
Life-threatening ventricular arrhythmias despite aggressive medical and device interventions	Marked cachexia (<60% ideal body weight) <b>won't tolerate surgery</b> Morbid obesity (>140% ideal body weight)
Cardiac tumors with low likelihood of metastasis	Osteoporosis
Hypoplastic left heart and complex congenital heart disease	Peripheral or cerebrovascular disease
Sometimes we know the reason of HF and we transplant heart because we know the patient won't make it out with any other surgery or the ejection fraction very low	<b>Systemic disease (anticipated to limit long-term survival) won't live long</b> , we may transplant heart for patient with chronic diseases if another organ gonna transplant for him, like patient with end stage kidney disease will transplant a kidney (for some reason transplanting 2 organs have higher success rate) -anyone with survival rate less than 2 years.



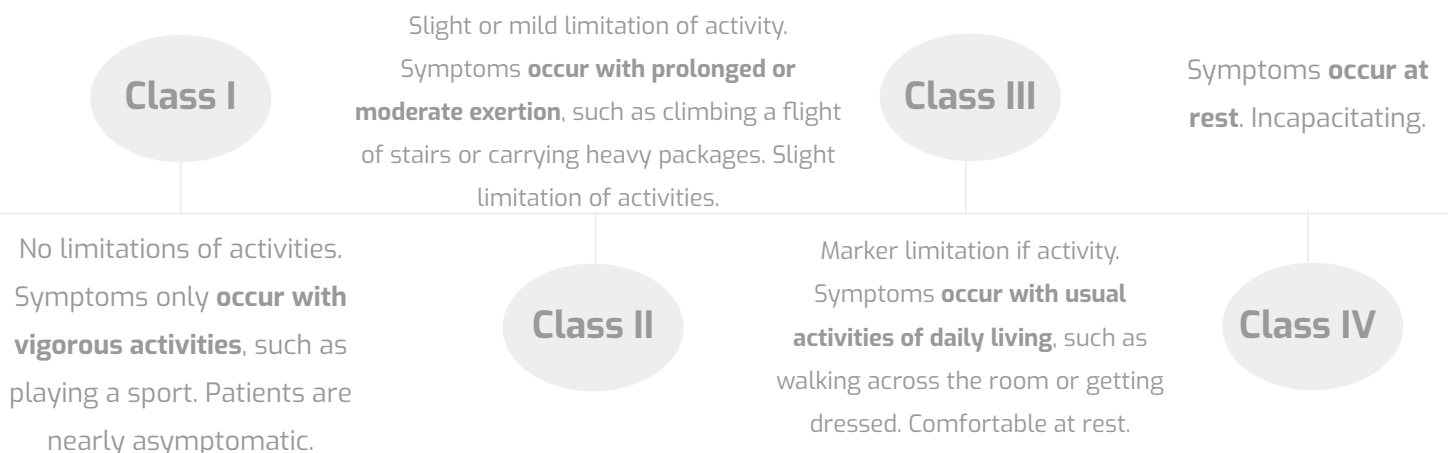
# Heart Failure

## Ventricular Assist Devices:

- All the indications for heart transplant are indications for assist device. Why we have two therapies for the same indications? Because heart transplant donor pool is limited, so if patient have an indication for hearts transplant and we don't have a heart yet we put him on waiting list (patient fails medical therapy his mortality 50% in two years so we have to implant an assist device)



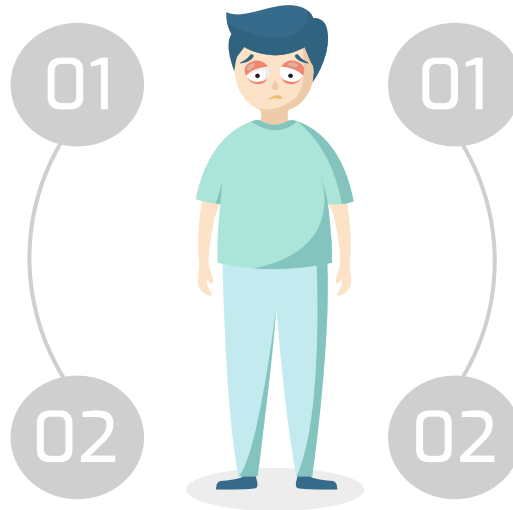
## NYHA classification: ★



# Cardiac Tumors

## Clinical Features

- The 2 most common manifestations of cardiac tumors are:
  - Obstruction **most common**
  - Embolization
- Nonspecific symptoms as fever, fatigue, and myalgias can be associated with cardiac tumors



## Investigations

- **Echocardiography**
- CT, MRI can be used as diagnostic modalities

### Primary Cardiac Tumors

Benign (75% of the cases)	Malignant (25% of the cases)
<ul style="list-style-type: none"> <li>• Myxoma</li> <li>• Rhabdomyoma</li> <li>• Fibroma</li> <li>• Lipoma</li> <li>• Atrioventricular node tumor</li> <li>• Papillary</li> <li>• Fibroelastoma</li> <li>• Hemangioma</li> </ul>	<ul style="list-style-type: none"> <li>• Rhabdomyosarcoma</li> <li>• Fibrosarcoma</li> <li>• Angiosarcoma</li> </ul>

## Management



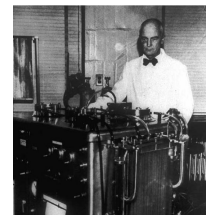
- **Benign?** We excise it but we take the size under consideration
- **Malignant?** Regardless the size we never excise it (not surgical)
- We can't do ventricular assist device because it's contraindicated

# Heart Lung Machine

**Heart-lung machine (cardiopulmonary bypass, CPB)** : gives the ability to stop the heart by causing hyperconcentration of potassium in pulmonary arteries leading to cardiac arrest.

● **Aim of cardiopulmonary bypass** : to facilitate cardiac and thoracic aortic procedures by excluding the heart and lungs from the circulation whilst providing:

1. Adequate gas exchange
2. Systemic organ perfusion
3. Controlling body temperature



In 1953, John Gibbon reported the first successful ASD closure using his heart-lung machine. It took him 20 years of work and experiments!

● **Components :**

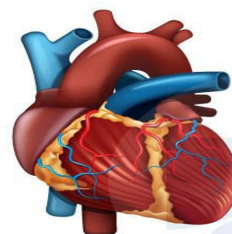
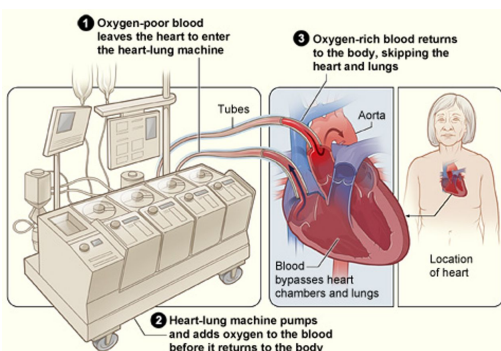
- Roller pumps
- Blood reservoir (cardiotomy reservoir)
- Oxygenator
- Heater-cooler unit
- Tubing & monitoring console etc.

● **Limitations/problems :**

- Requires full anticoagulation
- Can cause micro-embolism
- Initiates systemic inflammatory response

● **Complications :**

1. Systemic inflammatory response due to contact of blood with the non-endothelialized surface of CPB circuit → ↑ capillary permeability, interstitial edema, and subsequent organ dysfunction
2. Coagulopathy caused by platelet dysfunction + dilution & consumption of coagulation factors
3. Hemolysis
4. Cerebrovascular accident



**BENEFITS OF OFF PUMP CABG**

- Reduced incidence of stroke & cognitive problems
- Lesser renal dysfunction
- Reduced inflammatory response
- Lesser coagulopathy & requirement of blood transfusion
- Reduced length of time in intensive care & hospital stays
- Reduced morbidity & mortality rates

# Pericardial effusion

## Definition

Progressive accumulation of fluid inside the pericardial cavity, may compress the cardiac chambers.

### Etiology:

1. Traumatic
2. Pericarditis
3. Malignancy
4. Uremia
5. Post irradiation
6. Postoperative
7. Immunologic disorders

### Signs:

1. By palpation: impalpable apex beat
2. By percussion: dullness outside the apex
3. By auscultation: faint heart sounds
4. Compression of left lung: dullness & bronchial breathing below the inferior angle of left scapula in the back

### Management:

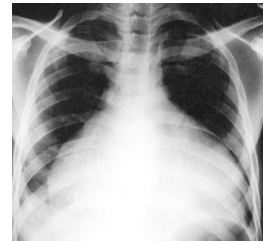
1. Treat the cause
2. Aspiration
3. Surgical drainage (pericardiostomy or pericardial window)

### Symptoms:

1. Pain may be similar to acute pericarditis or dull ache pain due distension of the pericardium
2. Dyspnea relieved by sitting up and leaning forwards

### Investigations:

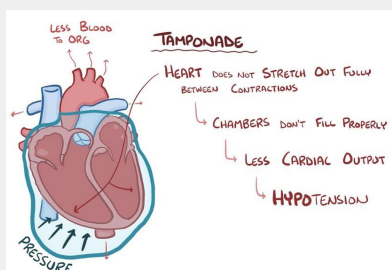
1. Plain x-ray chest
2. Echocardiography
3. CT scan



# Cardiac Tamponade

## 1 Effects of cardiac compression (tamponade):

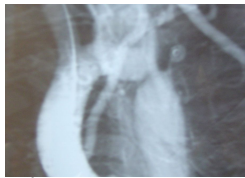
Cardiac compression prevents proper relaxation and diastolic filling of the heart → systemic venous congestion + low cardiac output



## 2 Clinical features:

1. Signs of low cardiac output: small pulse volume, low BP, tachycardia
2. Signs of systemic venous congestion: congested neck veins, Kussmaul sign (increase in JVP with inspiration) is unusual
3. Signs of pericardial effusion
4. Pulsus paradoxus
5. Shock in severe cases

# Congenital Heart Diseases



## Acyanotic

- Patent ductus arteriosus
- Coarctation of the aorta
- Pulmonary stenosis
- Atrial septal defect
- Ventricular septal defect

## Cyanotic

- Tetralogy of Fallot
- Transposition of the great vessels
- Tricuspid atresia
- Total anomalous venous drainage
- Truncus arteriosus

## Blunt Cardiac Trauma

In blunt cardiac trauma, the major challenge is **diagnosis**, while in penetrating cardiac trauma, the major challenges are **rapid resuscitation followed by emergent definitive surgery**

- Myocardial contusion
  - Pericardial tamponade
  - Arrhythmia with cardiac arrest
  - Disruption of valves and septum
  - Coronary artery injuries
  - Cardiac rupture
- All patients with blunt chest trauma should undergo physical examination, CXR, ECG, and baseline cardiac enzymes
  - ECHO, CT may be needed
  - Treatment depends on the nature of the injury



## Penetrating Cardiac Trauma

- All patients with penetrating wounds between the right midclavicular and left mid-axillary lines from the epigastrium to the clavicles should be assumed to have injuries involving the heart until proven otherwise.
- The most commonly injured chamber is the right ventricle.
- The typical patient presents with signs of tamponade or hemorrhage.
- Emergent surgical exploration may be needed.

# Cardiac Surgery

## Basic Principles of Cardiac Surgery

1. **Access**
  - Full or partial sternotomy
  - Thoracotomy
  - Robotic or endoscopic
- Bloodless operative field**
  - Suction & re-transfusion
  - Snaring
2. **Static operative target**
  - Cardiac arrest
  - Ventricular fibrillation
  - Mechanical stabilizers
3. **Preservation of body perfusion**
  - Use of heart lung machine
  - Off-pump techniques
4. **Preservation of myocardium**
  - Off-pump techniques
  - Hypothermia
  - Cardiac arrest with cardioplegia

<b>Pre-Operative Assessment for Cardiac Surgery</b>	<p><b>Evaluation of patients referred for cardiac surgery aims to answer the following questions:</b></p> <ol style="list-style-type: none"> <li>1. Is surgery appropriate for the condition?</li> <li>2. Is the patient fit to undergo the planned operation?</li> <li>3. Is there any comorbidity that may affect operative management?</li> <li>4. Is the pt agreeable to surgery given the benefit-to-risk ratio?</li> </ol>
<b>Pre-Operative Investigations for Cardiac Surgery</b>	<ul style="list-style-type: none"> <li>● Full blood count</li> <li>● Blood biochemistry</li> <li>● ECG</li> <li>● Chest X-ray</li> <li>● Pulmonary function tests</li> <li>● Carotid duplex scan</li> <li>● Echocardiography</li> <li>● Coronary angiography</li> <li>● Other test according to systematic review of patient e.g. peripheral duplex scan</li> </ul>
<b>Usual Duration of Hospital Stay</b>	<ul style="list-style-type: none"> <li>● One day before surgery</li> <li>● 5-6 hours OR time</li> <li>● 1-2 days in ICU</li> <li>● 4-5 days in ward</li> <li>● Total 5-7 days</li> </ul>







# Quiz!

**Q1: A 75-year-old woman with history of angina is admitted to the hospital for syncope. Examination of the patient reveals a systolic murmur best heard at the base of the heart that radiates into the carotid arteries. Electrocardiogram (ECG) is notable for left ventricular hypertrophy with evidence of left atrial enlargement. ECG reveals an aortic valve area of 0.7 cm<sup>2</sup>. What is the most appropriate next step in her management?**

1. Medical management with a nitrate and an angiotensin-converting enzyme inhibitor
2. Percutaneous coronary artery angioplasty and stenting
3. Aortic valve replacement
4. Tricuspid valve replacement

**Q2: A 70-year-old woman undergoes a cardiac catheterization for exertional chest pain. Her pain continues to worsen and she is interested in having either surgery or percutaneous coronary intervention (PCI). Which of the following would be an indication for her to undergo either coronary artery bypass grafting or PCI?**

1. Two-vessel coronary disease with proximal left anterior descending artery stenosis and depressed left ventricular ejection fraction
2. Isolated left main stenosis, no diabetes, and normal left ventricular ejection fraction
3. Left main stenosis and additional coronary artery disease with depressed left ventricular ejection fraction
4. Three-vessel coronary artery disease and diabetes

1 (2013)





# Quiz!

**Q3: A 45-year-old man with poorly controlled hypertension presents with severe chest pain radiating to his back. An ECG demonstrates no significant abnormalities. A CT scan of the chest and abdomen is obtained, which demonstrates a descending thoracic aortic dissection extending from distal to the left subclavian takeoff down to above the iliac bifurcation. A Foley catheter is placed, and urine output is 30 to 40 cc/h. His feet are warm, with less than 2-second capillary refill. Which of the following is the most appropriate initial management?**

1. Emergent operation for repair of the aortic dissection
2. Angiography to confirm the diagnosis of aortic dissection
3. Echocardiography to rule out cardiac complications
4. Initiation of a  $\beta$ -blocker
5. Initiation of a vasodilator such as nitroprusside

**Q4: A 56-year-old woman presents for evaluation of a murmur suggestive of mitral stenosis and is noted on echocardiography to have a lesion attached to the fossa ovalis of the left atrial septum. The mass is causing obstruction of the mitral valve. Which of the following is the most likely diagnosis?**

1. Endocarditis
2. Cardiac myxoma
3. Lymphoma
4. Cardiac sarcoma
5. Metastatic cancer to the heart

2 (4) | 7 (E)





# Quiz!

**Q5: For each physical finding or group of findings, select the cardiovascular disorder with which it is most likely to be associated. Each lettered option may be used once, more than once, or not at all.**

- A. Massive tricuspid regurgitation**
- B. Aortic regurgitation**
- C. Coarctation of the aorta**
- D. Thoracic aortic aneurysm**
- E. Myocarditis**

1. An elderly man with abnormal pupillary responses (Argyll Robertson pupil).
2. A 24-year-old drug addict with jugular venous distention and exophthalmos.
3. A patient with flushing and paling of the nail beds (Quincke pulse) and a bounding radial pulse.
4. A patient with conjunctivitis, urethral discharge, and arthralgia.
5. A patient with short stature, webbed neck, low-set ears, and epicanthal folds.

1) D | 2) A | 3) B | 4) E | 5) C



## القادة

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## الأعضاء

مرام بياري

أجوان الجهني

جنى الحازمي

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شكر خاص لتيم الجراحة دفعة ٤٤١، ٤٣٩

حسبي الله لا إله إلا هو عليه توكلت وهو رب العرش العظيم.  
اللهم إني أستودعك ما قرأت وما حفظت وما تعلمت فرده لي عند حاجتي إليه إنك على كل شيء قدير.



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